STRAIGHT
CARRIER

BRUSH

OPERATING INSTRUCTIONS

DUAL CHANNEL D.C. AMPLIFIER

MODEL BL-530

MP MASTER
MA34652

brush

DUAL CHANNEL D.C. AMPLIFIER

MODEL BL-530

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

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WARRANTY

Each instrument manufactured by Brush Instruments, Division of Clevite Corporation, is warranted to be free from defects in material and workmanship and to operate in accordance with the published specifications when used with the recommended Brush associate equipment and with Brush chart paper. Liability under this warranty is limited to servicing or adjusting any instrument returned to a factory branch service station for that purpose and to replacing any defective parts thereof except tubes, fuses, and batteries.

This warranty is effective for one year after delivery to the original purchaser. When the instrument is returned tansportation charges are to be prepaid by the original purchaser. If defective operation has been caused by misuse or abnormal conditions of operation, repairs will be billed at our current rate. In this case an estimate will be submitted before work is started.

SUPPLIES AND SERVICE

Brush Instruments factory branch offices and service stations:

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BOSTON
Brush Instruments
New England District Office
Factory Sales & Service
Northwest Industrial Park
Burlington, Massachusetts
Phone: Browning 2-0750

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Factory Sales & Service
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Riverdale, Maryland
Phone: Union 4-0057

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300 Speer Boulevard
Denver 3, Colorado
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Factory Sales & Service
1960 So. LaCienega Blvd.
Los Angeles 34, California
Phone: Upton 0-7517

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Brush Instruments
District Office, 61 Renato Court
Redwood City, California
Phone: Emerson 9-5581

DUAL CHANNEL D.C. AMPLIFIER Model BL-530

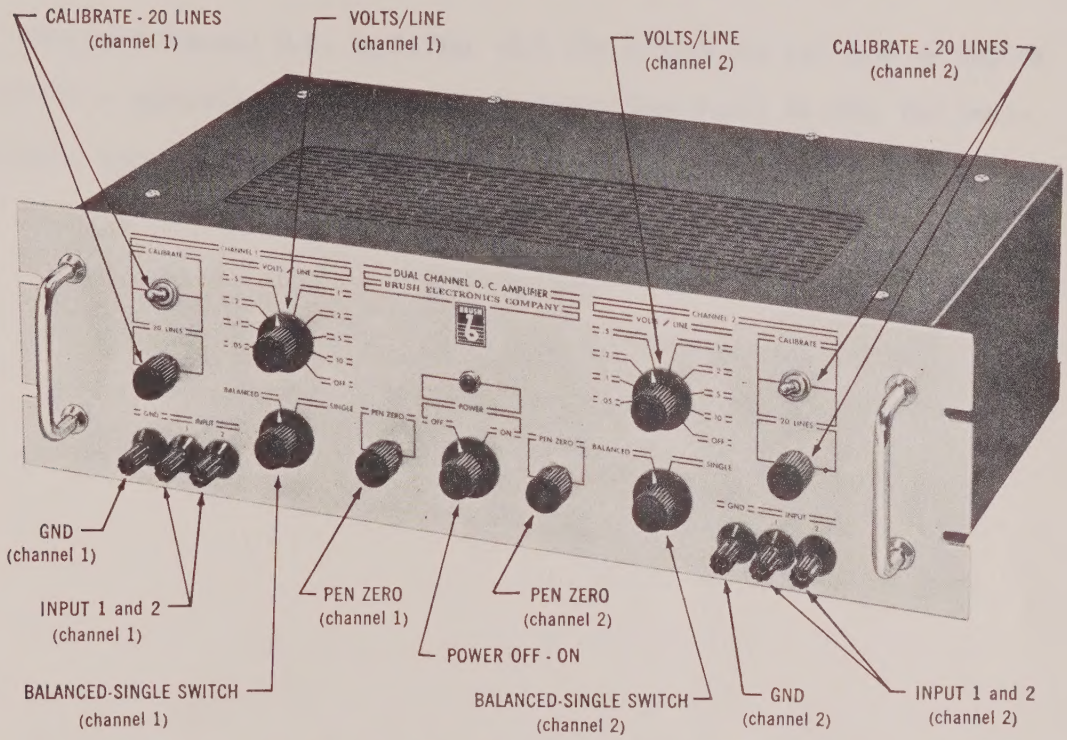

Fig. 1. Dual Channel D.C. Amplifier Model BL-530.

The Brush Dual Channel D.C. Amplifier Model BL-530 is designed to amplify two separate signals independently of each other in the voltage range between 50 millivolts and 400 volts. It has a linear response from 0 (d.c.) to 5000 cycles per second when used with any oscilloscope or similar apparatus. The Amplifier consists of two channels of balanced, direct coupled amplification with a maximum voltage gain of 25 each; an electronically-regulated power supply and a standard cell for calibration. An input switch permits the acceptance of either balanced or single ended input signals. The signal zero line may be offset up to an equivalent of 200 lines of chart paper, either side of chart center when single ended input circuits are used. This makes it possible to balance out an unwanted d.c. component and to amplfy the dynamic component of a complex signal.

This Dual Channel D.C. Amplifier will fit a standard 19" rack or may be mounted in a specially designed Brush Portable Case Model BL-380, for semi-permanent, table-top applicantions.

Maximum sensitivity	50 millivolts per chart line. Full scale deflection ± 1 volt.
Measurement range	Single ended input - .050 volt to 400 volts. Balanced input - .050 volt to 20 volts. Maximum ± 10 volts each terminal to ground.
Zero line stability	1/4 line of chart paper per hour. (Not affected by power line fluctuations between 105 and 125 volts or between 95 and 115 volts.) Total drift over eight hour period not more than 1/2 line of chart paper.
Input impedance	1 megohm (single ended), and 900 K ohms (balanced).
Signal expander	A pen positioning control is provided. Permits balancing out the d.c. or static component of a complex signal up to the equivalent of 200 lines either side of chart center, except when balanced input is used.
Attenuator steps	.05, .1, .2, ;5, 1, 2, 5, and 10 volts per chart line.
Frequency response	Flat from d.c. to 100 cps when matched with Brush oscillographs. An adjustment is provided for flat response within 3 db from d.c. to 5 kc for use with oscilloscopes or for similar applications.

Calibration	1.0 volt signal derived from internal mercury cells.
Output impedance	Approximately 50 ohms.
Output voltage	30 volts. Because of bridge type output circuit, output terminals are operated at 30 volts above chassis.
Output current	20 ma into 1500 ohms.
Input power required	105 to 125 volts (or 95 to 115 volts), 50 to 2000 cps, 95 watts (nominal). See ROUTINE ADJUSTMENT and MAINTENANCE.
Fuse	2 amp, 250 volts, type 3AG.
Tubes	Each pen drive amplifier: 1 - 5751, 2 - 12AT7WA, and 2 - 5687. Power supply: 1 - 0A2, 1 - 6X4, 1 - 6080, 1 - 5751, and 2 - 3TF4.
Dimensions	Standard panel: 19" wide x 5 1/4" high x 1/4" thick. Depth: 10 3/4" (with connectors 12 1/2").
Net weight	22 pounds.
Shipping weight	28 pounds.

INSTALLATION

Two types of mountings are available, rack or portable case. Installation of the Dual Channel Amplifier in a standard 19" rack (customer supplied) is simply a matter of placing the instrument in the rack and fastening it in position with four screws through the front panel. This is a permanent installation and designed for use with other rack mounted instruments.

For maximum portability the Brush Portable Case Model BL-380, (20 1/8" wide, 6 3/8" high and 1- 3/8" deep, with a dark grey metallic finish) is recommended. When the Dual Channel Amplifier and the Portable Case are purchased together the amplifier is installed in the case at the factory. If purchased separately, installation instructions are furnished with the Portable Case.

WARNING

Because the chassis is common to one side of each amplifier circuit, it is necessary to check the circuitry of the two signals to be recorded to ascertain whether the common amplifier circuit will adversely affect their operation. Normal operation of the amplifier requires grounding of the chassis. If it is not possible to ground one side of each circuit whose signal is to be recorded, the amplifier may be operated off ground when not mounted in a rack. Precautions must be taken for off-ground operation to protect the operator from electrical shock as the amplifier case will be at the potential of the common side of the circuits.

NOTE:

THE OUTPUT TERMINALS OF THIS AMPLIFIER ARE 30 VOLTS ABOVE CHASSIS. THEREFORE, SOME OF THE EARLIER BRUSH OSCILLOGRAPHS, Models BL-201, BL-202, BL-221, and BL-222, MAY REQUIRE THE REMOVAL OF AN EXISTING PEN-MOTOR LEAD TO THE CHASSIS. ALL BRUSH OSCILLOGRAPHS, Models BL-206 AND BL-208, MUST BE CONVERTED FOR USE WITH THIS AMPLIFIER. SEE BELOW.

All other Brush Oscillographs need no conversion. Present owners of the "BL-200 series" of oscillographs may determine if the penmotor coil of their particular oscillograph is connected to the chassis by disconnecting the input cable from the oscillograph, turning the ON-OFF switch to "ON", and measuring the resistance from each of the two large pins of the four prong input connector to the oscillograph chassis. If the resistance is infinite, the oscillograph will operate satisfactorily with the Dual Channel D. C. Amplifier. If the resistance between either of the two large pins and the chassis is found to be zero (0) or about 1500 ohms, any connection from the penmotor leads to the chassis (usually found at the input socket of the oscillograph) must be removed.

ALL BRUSH OSCILLOGRAPHS, MODELS BL-206 AND BL-208, MUST BE CONVERTED FOR USE WITH THE DUAL CHANNEL D.C. AMPLIFIER. The Brush Service Department will be very glad to supply the information to make this conversion.

When operating the Amplifier Model BL-530 with balanced input, the signals to be recorded must be checked to determine that the inphase component is no greater than $\pm$ 10 volts.

CONTROLS AND CONNECTORS

The controls and connectors on the front panel are as follows:

POWER OFF-ON. . . . . ."ON-OFF" Switch for both channels.

The following controls and connectors are in duplicate (one for each channel). They are marked CHANNEL 1 on the left side (facing the panel) and CHANNEL 2 on the right side.

CALIBRATE-20 LINES. . . . . .Continuously variable gain control for calibrating amplifier-oscillograph combination, using an internal mercury cell as a reference voltage.

VOLTS/LINE. . . . . .Step control to attenuate input signal to amplifier.

BALANCED-SINGLE. . . . . Selector switch either for balanced or single ended input.

PEN ZERO. . . . . .Adjusts pen position on chart to desired setting, except when balanced input is used.

GND. . . . . GR type terminal permits grounding of the amplifier chassis or connecting several instruments to a common ground.

INPUT 1 and 2. . . . . GR type terminals for either single ended or balanced input signal. When a single ended input is used, connect the side of circuit to be grounded to terminal 1 and the other side of circuit to terminal 2. When a balanced input is required, connect one side of circuit to terminal 1 and the other side of circuit to terminal 2. The neutral or ground connection

of the balanced input is connected to the GND (ground) terminals. The d.c. voltage level of the balanced input circuit should not exceed ± 10 volts.

The controls and connectors on the rear panel are as follows:

POWER Input. . . . . Connects power source to amplifier (2 pin recessed male connector).

The following controls and connectors are in duplicate (one for each channel). Channel 2 is on the left side (facing the rear panel), while Channel 1 is on the right side. This is in contrast to the front panel control positions, but places the controls on the rear panel directly behind the respective controls of each channel on the front panel.

NARROW COMP. . . . . Frequency compensator for matching penmotor. (See ROUTINE ADJUSTMENT and MAINTENANCE.)

BROAD COMP. . . . . .Same as above.

TUBE ADJ. . . . . To be used only in case of tube replacement. (See ROUTINE ADJUSTMENT and MAINTENANCE.)

INPUT 1 and 2. . . . . This connector is in parallel with the GND and INPUT 1 and 2 terminals on the front panel. Pin "A" is in parallel with GND (ground); pin "B" is in parallel with INPUT 1; pin "C" is in parallel with INPUT 2. (3 pin male AN connector.)

OUTPUT 1 and 2. . . . . .Connects amplifier output to oscillograph or other equipment (6 pin female AN connector).

OPERATING PROCEDURE

Since each side of this Dual Channel Amplifier is a separate and complete amplifier except for a common chassis circuit, these operating procedures will consider only one channel unless specified otherwise. The information is applicable to either or both sections of the amplifier, i.e., CHANNEL 1 or CHANNEL 2 may be operated separately or both simultaneously without interference of one with the other. To operate proceed as follows:

1. Determine that the main power switch of the oscillograph is in the "OFF" position and connect the amplifier to the oscillograph.
2. Connect power cable to POWER input (on the rear panel of the amplifier) and to a 115 volt a.c. power source.
3. Turn both VOLTS/LINE Switches to "OFF".
4. Turn POWER Switch to "ON". Allow 10 to 15 minutes for the amplifier to warm up.
5. Turn BALANCED-SINGLE Switch to BALANCED.
6. Turn PEN ZERO fully counterclockwise and then clockwise five full turns. (The full range of this control is ten turns-thus five full turns from either right or left stop constitutes approximately the middle position.)
7. Connect the oscillograph to an appropriate power source and turn the oscillograph to "ON" at slow chart paper speed. (This is to conserve paper during adjustment period.)

8. Pen should center on the center line of the chart paper. If pen is slightly off-center, adjust to center position by means of the appropriate (channel 1 or 2) TUBE ADJ control on the rear of the chassis. Turn BALANCED-SINGLE switch to "SINGLE". Center pen on chart using the appropriate (channel 1 or 2) PEN ZERO control on the front panel.
9. Depress CALIBRATE Switch and adjust 20 LINES-CALIBRATE control for 20 lines of pen deflection. Release CALIBRATE switch.
10. Check 20 line deflection by again depressing CALIBRATE switch. If necessary, re-adjust as in step 9, above.
11. Connect the signal input to the amplifier by means of either the front (GR) terminals or the back (AN) connector.

When connecting a single ended input at the front panel, the "hot" side (in reference to ground) must be connected to INPUT 2 and the side of circuit to be grounded to INPUT 1. If the rear panel input connector is used, the "hot"side of the signal must be connected to pin "C" and the ground to pin "B". When a balanced input signal is connected at the front panel, one side of the circuit is connected to INPUT 1 and the other side to INPUT 2. When a balanced input signal is connected to the rear panel input connector, one side of the circuit is connected to pin "B", and the other side to pin "C". The balanced input circuit may be grounded to the GND (ground) terminal at the front panel, or to pin "A" of the rear panel input connector.

12. Adjust pen to desired position on chart paper with PEN ZERO control.

13. Turn VOLTS/LINE Switch to 10, 5, etc., in successive steps to reach desired sensitivity.

The signal voltage is equal to the number of lines of deflection from pen zero, multiplied by the VOLTS/LINE setting.

OFF CENTER ZERO OPERATION

(When using single ended input only)

Under certain conditions, more complete information regarding the dynamic component of a complex signal is required. It is possible, by adjusting the zero position of the signal off the chart paper, to cancel the static component and magnify the amplitude of the recording of the dynamic component. After displaying the signal on an appropriate VOLTS/LINE setting, turn the VOLTS/LINE switch to the next lower setting. Follow this by turning the PEN ZERO control until the pen records equal amplitude of the dynamic signal component on either side of the center line of chart paper. Note: This step is particularly important. The above procedure may be repeated until the signal amplitude is as great as possible without exceeding 40 lines (peak to peak) or until the d.c. (static signal component) center shift is 200 lines off chart center, which is the maximum available shift on any VOLTS/LINE switch position. The peak to peak voltage of the signal under observation is equal to the number of chart lines (peak to peak) multiplied by the setting of the VOLTS/LINE switch.

ROUTINE ADJUSTMENT and MAINTENANCE

This amplifier has been accurately balanced and adjusted before shipment from the factory and should give long, trouble-free service. This amplifier is normally wired to operate with from 105 to 125 volts input. If however, the prevailing power supply is from 95 to 115 volts, a slight modification of the wiring of the power transformer (T-1) will accommodate this condition. See Tube Layout (Fig. 2) and the schematic wiring diagram. To make this modification disconnect the input power lead and capacitor lead from terminal "3" of the power transformer. Re-connect these same two leads to terminal "2" of the same transformer. The lead which connects terminal "3" to the separate filament transformer (T-2) should be re-soldered to terminal "3" of the power transformer (T-1). This modification will be made at the factory, if requested at time of ordering. For any servicing except the above modification and tube replacement, the instrument should be sent back to the factory where facilities are available to restore it to its original condition.

TUBE REPLACEMENT

To replace any faulty tube, disconnect all cables and expose the chassis. If the amplifier is portable case mounted, remove the top and bottom screws as well as the four screws on the front panel and withdeaw the amplifier. If the amplifier is rack mounted, remove from the rack and take off the top portion of the wrap-around cover. In either case, all tubes will be exposed.

Dual Channel D. C. Amplifier Model BL-530

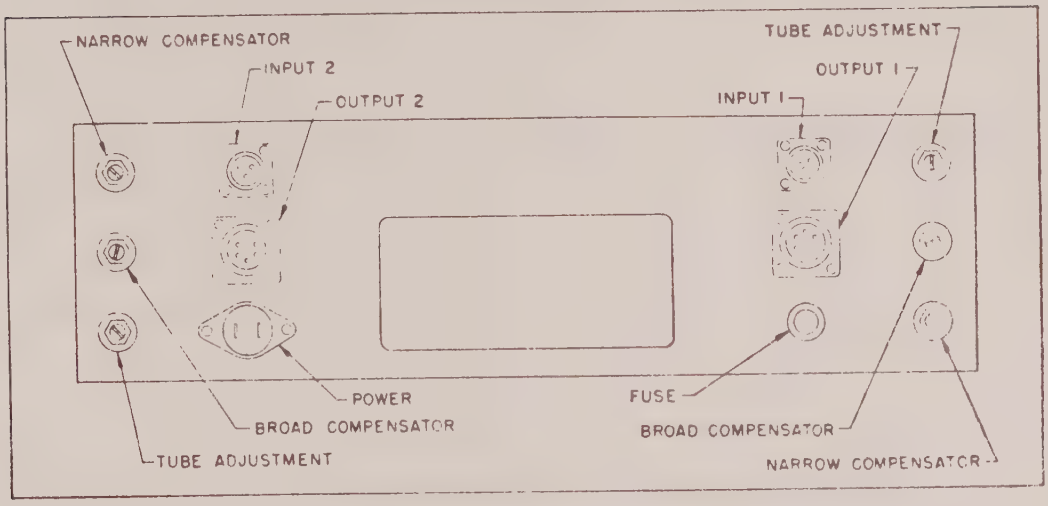

Fig. 3. Rear Panel of Amplifier.

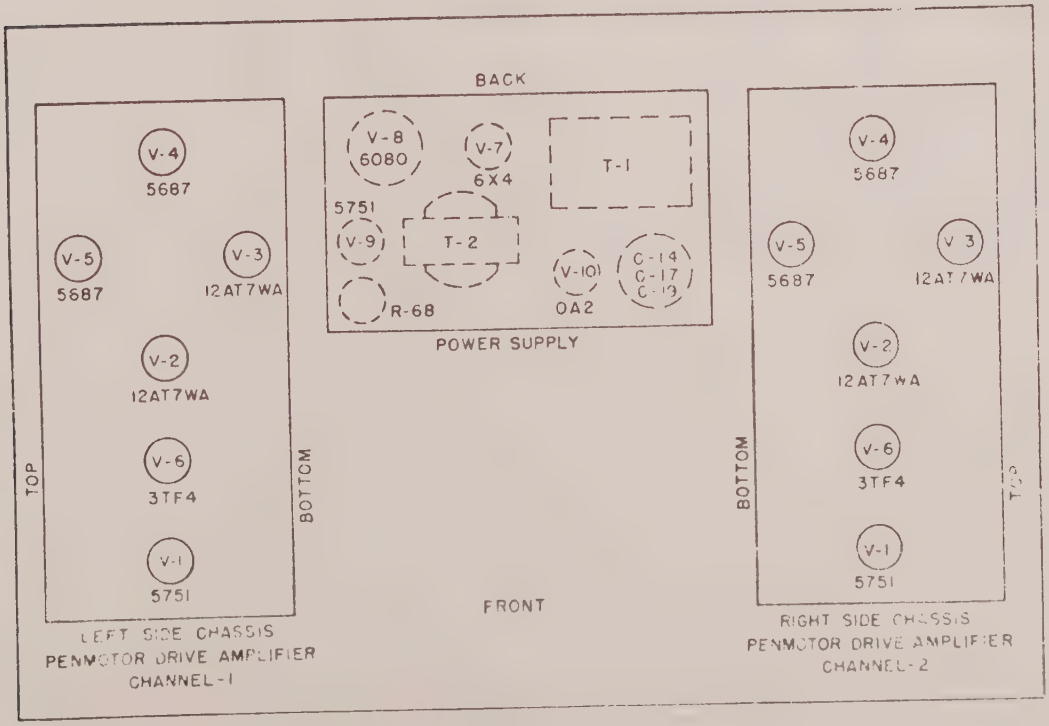

Fig. 2 Tube Layou:

Either Side Chassis

(Channel 1 or 2)

After replacement of any tube in either side chassis proceed as outlined under Operating Procedure.

Power Supply Chassis

Following the replacement of any tube in this section (Fig. 2) the +B voltage must be checked and adjusted. The voltage between the case of the filter capacitor and pin 5 of the OA2 tube must be adjusted to 213 volts (± 5 volts) when the output tubes are 6AF4 type or to 225 volts (± 5 volts) when the output tubes are 5687 type. This adjustment is made using the voltage control on the power supply chassis.

Following any tube replacement, restore the top portion of the wrap-around cover and replace the instrument in the rack or remount in the portable case.

FREQUENCY COMPENSATION

To obtain optimum frequency response of an amplifier-oscillograph combination, the frequency response of the amplifier must be adjusted to match the penmotor of the oscillograph. (When an amplifier and an oscillograph are purchased together, this adjustment is made at the factory.)

To match either channel 1 or channel 2 of the amplifier to an oscillograph, proceed as follows:

1. Warm up amplifier (10 to 15 minutes).

2. Adjust pen pressure of oscillograph with a gram gage. (See Operating Instructions for the Oscillograph.)

3. Put BALANCED-SINGLE switch in the "SINGLE" position.

4. Connect an oscillator covering the range from 10 to 100 cps to INPUT 1 and INPUT 2 on the front panel. If the corresponding input (AN) connector on the rear panel is used, pins "B" and "C" correspond to the GR terminals marked "INPUT 1 and 2" on the front panel. Fig. 1.

5. Turn the BROAD COMP (broad compensator) switch fully counterclockwise.

6. At 10 cps adjust oscillator output level for 10 lines total pen deflection (peak to peak).

   Note: The pen deflection is a product of the oscillator output voltage, the VOLTS/LINE setting and the setting of the CALIBRATE - 20 LINES control. Note the oscillator output voltage as it is the reference voltage and must remain constant during the frequency compensation.

7. At 100 cps (with oscillator output voltage the same as in step 6, above) adjust the NARROW COMP (narrow compensator) for maximum pen deflection. If maximum pen deflection thus obtained is less than 10 lines, advance the BROAD COMP (broad compensator) clockwise by steps until the maximum pen deflection obtainable by adjustment of the NARROW COMP (narrow compensator) is at least 10 lines. (If extreme or erratic pen deflections are observed, the condition is due to oscillations within the amplifier. This is corrected by slowly turning the NARROW COMP in a counterclockwise

direction until the condition ceases.)

8. If maximum pen deflection thus obtained is over 10 lines, adjust NARROW COMP (narrow compensator) counterclockwise until a pen deflection of 10 lines is obtained. Test for flatness of response from 100 to 10 cps.

9. Re-set input voltage at 100 cps as in step 7, above. Adjust NARROW COMP (narrow compensator) clockwise through the maximum pen deflections until a pen deflection of 10 lines is again obtained. Again test for flatness of response from 100 to 10 cps.

10. The best frequency response of the amplifier-oscillograph combination will be either that obtained in step 8 or step 9. This selection may be determined by comparing the two graphs.

NOTE: In cases where extended frequency response is desired (when the amplifier is being used with an oscilloscope or for similar applications), turn the BROAD COMP (broad compensator) control fully clockwise.

TROUBLE SHOOTING

GENERAL

Symptom	Cause	Remedy
1. Dead, pilot lamp not lighted.	a. Power cable disconnected	a. Connect to power source.
	b. Fuse open.	b. Replace fuse.
	c. Power switch turned off.	c. Turn on.
	d. No line voltage.	d. Connect to proper power.
2. Dead, pilot lamp lighted.	a. Defective cable to oscillograph.	a. Repair.
	b. Inoperative 6X4, 6080, 5751, 3TF4, 3TFV4, 12AT7 Tubes	b. Replace.

AMPLIFIER SECTION

1. Pen off chart. Selector Switch at BALANCED position.	a. Improper plate voltage (213 volts ± 5V., 225 volts ±.5V. for serial #1194 and higher).	a. Adjust voltage of power supply. See Operating Instructions.
	b. Inoperative tubes, particularly 6AF4A, 5687.	b. Replace.
	c. Improperly adjusted TUBE ADJUST.	c. Adjust according to Operating Instructions.
	d. Grounded output leads to penmotor.	d. Replace changed component.
	e. Component values changed.	e. Replace changed component.

AMPLIFIER SECTION

(continued)

Symptom	Cause	Remedy
2. Pen on chart, but off center. Selector switch at BALANCED position.	a. If less than 5mm., improper adjustment of TUBE ADJUST control.	a. Adjust according to Operating Instructions.
	b. If more than 5mm.,inoperative tube or components value changed.	b. Replace.
3. PEN ZERO inoperative. Selector switch at SINGLE position.	a. 3TF4,3TFV4 ballast tube inoperative.	a. Replace with 3TF4 only.
	b. 5751 tube inoperative.	b. Replace.
	c. Lead from PEN ZERO arm to Pin #7, of first stage tube(5751)open or grounded.	c. Repair or replace lead.
	d. Voltage divider taps grounded.	d. Repair.
4. Balances but drift exceeds 1/2mm.per hour.	a. Plate voltage supply not regulating.	a. See "B+ to B- Regulated Voltage Varies".
	b. Excessive line voltage variation.	b. Connect to proper power source.

AMPLIFIER SECTION

(continued)

Symptom	Cause	Remedy
4. Continued	c. Grid current in 5751 tube (does not occur when pen is biased to right side of chart).	c. Replace tube.
	d. Feed-back circuit inoperative.	d. Replace defective component in feed-back circuit.
	e. Weak tubes.	e. Replace.
5. Calibrate level inadequate, (Output should exceed 21.7 volts across 1500 ohm resistive load when calibrate switch is depressed.)	a. 5751, 12AT7, 5687 or 6AF4 tubes weak.	a. Replace.
	b. Calibrate cell contacts dirty.	b. Clean contacts.
	c. Calibrate cell dead.	c. Replace.
	d. Standard cell on early models inoperative when front panel is horizontal, rather than vertical.	d. Re-position cell or amplifier.
6. Output with no input.	a. If approx. 125 cps, compensation controls misadjusted	a. Adjust according to Operating Instructions.

AMPLIFIER SECTION

(continued)

Symptom	Cause	Remedy
6. Continued	b. If 120cps, with 20 LINES control counter-clockwise, and output exceeds .050V. inoperative filter capacitor.	b. Replace filter capacitor.
	c. If 60cps, cathode to heater leakage in any tube.	c. Replace defective tube.
	d. If random, noisy resistor.	d. Replace.
	e. Noisy 5751,12AT7,5687 or 6AF4A tube.	e. Replace tube.
	f. Oscillation in 0A2 tube.	f. Replace tube.
	g. Inoperative filter capacitor.	g. Replace capacitor.
	h. Defective 6X4 or 6080 tube.	h. Replace.
7. VOLTS/LINE attenuator steps incorrect.	a. Resistors in attenuator changed value.	a. Replace.
	b. Grounded resistors or switch contacts.	b. Remove ground.

AMPLIFIER SECTION

(continued)

Symptom	Cause	Remedy
8. Cannot be frequency compensated to oscillograph (dc to 100cps ± 1mm. at 10mm. peak to peak reference.	a. Improper compensation procedure.	a. Adjust according to Operating Instructions.
	b. Frequency compensation network component inoperative, or grounded to shield can.	b. Replace or repair.
	c. Defective tube.	c. Replace.
9. Calibrate switch erratic.	a. Defective calibrate switch.	a. Replace.
10. 6AF4A tubes are short-lived.	a. Tubes become "poisoned".	a. Replace with conversion kit using 5687 tubes. Inquire of Brush Service Department for details.
11. D.C. Linearity poor.	a. Weak tubes.	a. Replace.
	b. Penmotor non-linear.	b. Connect to linear Penmotor.
12. Random "pips" on oscillograph chart.	a. Power line transients.	a. Install line filter, Brush #123361.
	b. Local interference sources such as electric adding machines, etc.	b. Isolate interference source from amplifier.

AMPLIFIER SECTION

(continued)

Symptom	Cause	Remedy
13. Both channels have simultaneous output with input signal applied to only one.	a. Grounded output leads to- or in - penmotor.	a. Remove ground or replace penmotor.

POWER SUPPLY

1. B+ to B- Regulated Voltage Varies.	a. Power line voltage too low.	a. Connect to proper power source.
	b. Inoperative 0A2,6080,5751, or 6X4 tube.	b. Replace.
	c. Oscillation in plate supply.	c. Replace 0A2 tube.
	d. Output filter capacitor open.	d. Replace.
	e. Heater voltage to 6080 tube too low.	e. Replace transformer.

PARTS LIST

SYMBOL	DESCRIPTION	VALUE	BRUSH PART NO.
B-1	Cell, Mercury	1.35V, ± 1%	2-119701-1
C-1	Capacitor, Paper	2 mfd, ± 10%, 200V	10-120554-205
C-2	Capacitor, Mica	470 mmfd, ± 5%, 500V	5-117264-471
C-3	Capacitor, Mica	.001 mfd, ± 5%, 500V	5-117264-102
C-4	Capacitor, Mica	.001 mfd, ± 5%, 500V	5-117264-102
C-5	Capacitor, Mica	.001 mfd, ± 5%, 500V	5-117264-102
C-6	Capacitor, Mica	.001 mfd, ± 5%, 500V	5-117264-102
C-7	Capacitor, Mica	.001 mfd, ± 5%, 500V	5-117264-102
C-8	Capacitor, Mica	470 mmfd, ± 5%, 500V	5-117264-471
C-9	Capacitor, Mica	680 mmfd, ± 5%, 500V	5-117264-681
C-10	Capacitor, Mica	.0015 mfd, ± 5%, 500V	5-117265-152
C-11	Capacitor, Mica	.0022 mfd, ± 5%, 500V	5-117265-222
C-12	Capacitor, Paper	.01 mfd, ± 10%, 600V	10-217260-103
C-13	Capacitor, Paper	.01 mfd, ± 10%, 600V	10-217260-103
C-14	Capacitor, Electrolytic (⅓ Triple Section)	20 mfd, 450V	117718-206
C-15	Capacitor, Paper	.01 mfd, ± 10%, 400V	10-217413-103
C-16	Capacitor, Mica	.0022 mfd, ± 10%, 500V	10-117265-222
C-17	Capacitor, Electrolytic	20 mfd, 450V	(See C-14)
C-18	Capacitor, Paper	.25 mfd, ± 10%, 400V	10-120554-254
C-19	Capacitor, Electrolytic	20 mfd, 450V	(See C-14)

PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	VALUE	BRUSH PART NO.
E-1	Lamp, Incandescent	Type 51	105796-1
F-1	Fuse, 2 Amp., 250V	Type 3AG	102625
J-1	Binding Post (3)	GR Type	119741-3
J-2	Connector, Female	Strip Type	2-122555-2
J-3	Connector, Female	Strip Type	2-122555-5
J-4	Receptacle, Female	AN Type	119990
P-1	Receptacle, Male	AN Type	121274
P-2	Receptacle, Male		6526
R-1	Resistor, Precision	5.0M, ± 1%, ½W	1-117802-5004
R-2	Resistor, Precision	5.0M, ± 1%, ½W	1-117802-5004
R-3	Resistor, Precision	75K, ± 1%, 1W	1-117803-7502
R-4	Resistor, Variable, 10 Turn	50K	5-117686-503
R-5	Resistor, Precision	9.1K, ± 1%, ½W	1-117802-9101
R-6	Resistor, Precision	9.1K, ± 1%, ½W	1-117802-9101
R-7	Resistor, Precision	50K, ± 1%, 1W	1-117803-5002
R-8	Resistor, Precision	500K, ± 1%, ½W	1-117802-5003
R-9	Resistor, Precision	1.0M, ± 1%, ½W	1-117802-1004
R-10	Resistor, Precision	750K, ± 1%, 1W	1-117803-7503
R-11	Resistor, Precision	330K, ± 1%, ½W	1-117802-3303
R-12	Resistor, Precision	900K, ± 1%, 1W	1-117803-9003
R-13	Resistor, Precision	110K, ± 1%, ½W	1-117802-1103
R-14	Resistor, Precision	950K, ± 1%, 1W	1-117803-9503
R-15	Resistor, Precision	26K, ± 1%, ½W	1-117802-2602
R-16	Resistor, Precision	16.5K, ± 1%, ½W	1-117802-1652
R-17	Resistor, Precision	5.05K, ± 1%, ½W	1-117802-5051
R-18	Resistor, Precision	5.05K, ± 1%, ½W	1-117802-5051
R-19	Resistor, Precision	350K, ± 1%, ½W	1-117802-3503
R-20	Resistor Assembly, Variable	1M, ± 0.5%	223262-501
R-21	Resistor, Precision	250K, ± 1%, ½W	1-117802-2503
R-22	Resistor, Precision	2.5M, ± 1%, ½W	1-117802-2504
R-23	Resistor, Precision	5M, ± 1%, ½W	1-117802-5004
R-24	Resistor, Composition	1.2K, ± 5%, ½W	5-115557-122
R-25	Resistor, Precision	250K, ± 1%, ½W	1-117802-2503
R-26	Resistor, Composition	1.2K, ± 5%, ½W	5-115557-122
R-27	Resistor, Precision	5M, ± 1%, ½W	1-117802-5004
R-28	Resistor, Precision	2.5M, ± 1%, ½W	1-117802-2504
R-29	Resistor, Precision	250K, ± 1%, ½W	1-117802-2503
R-30	Resistor, Precision	6.8M, ± 1%, 1W	1-117803-6804
R-31	Resistor, Precision	2.2M, ± 1%, ½W	1-117802-2204
R-32	Resistor, Precision	2.2M, ± 1%, ½W	1-117802-2204
R-33	Resistor, Precision	6.8M, ± 1%, 1W	1-117803-6804

PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	VALUE	BRUSH PART NO.
R-34	Resistor, Composition	100K, ± 5%, ½W	5-115557-104
R-35	Resistor, Composition	3.6K, ± 5%, ½W	5-115557-362
R-36	Resistor, Variable	3K, ± 20%, ½W	20-125156-302
R-37	Resistor, Composition	3.6K, ± 5%, ½W	5-115557-362
R-38	Resistor, Composition	100K, ± 5%, ½W	5-115557-104
R-39	Resistor, Precision	1.1M, ± 1%, ½W	1-117802-1104
R-40	Resistor, Precision	510K, ± 1%, ½W	1-117802-5103
R-41	Resistor, Composition	11K, ± 5%, ½W	5-115557-113
R-42	Resistor, Precision	510K, ± 1%, ½W	1-117802-5103
R-43	Resistor, Precision	1.1M, ± 1%, ½W	1-117802-1104
R-44	Resistor, Composition	100K, ± 5%, ½W	5-115557-104
R-45	Resistor, Precision	1.72M, ± 1%, ½W	1-117802-1724
R-46	Resistor, Precision	470K, ± 1%, ½W	1-117802-4703
R-47	Resistor, Composition	18K, ± 5%, ½W	5-115557-183
R-48	Resistor, Precision	470K, ± 1%, ½W	1-117802-4703
R-49	Resistor, Precision	1.72M, ± 1%, ½W	1-117802-1724
R-50	Resistor, Composition	100K, ± 5%, ½W	5-115557-104
R-51	Resistor, Composition	1.1K, ± 5%, 2W	5-115559-112
R-52	Resistor, Composition	680 Ohms, ± 5%, ½W	5-115557-681
R-53	Resistor, Composition	2.2M, ± 5%, ½W	5-115557-225
R-54	Resistor, Composition	1.0M, ± 5%, ½W	5-115557-105
R-55	Resistor, Composition	1.0M, ± 5%, ½W	5-115557-105
R-56	Resistor, Variable	1.0M	19-211473-105
R-57	Resistor, Composition	1.0M, ± 5%, ½W	5-115557-105
R-58	Resistor, Composition	1.0M, ± 5%, ½W	5-115557-105
R-59	Resistor, Composition	2.2M, ± 5%, ½W	5-115557-225
R-60	Resistor, Composition	68 Ohms, ± 5%, 1W	5-115558-680
R-61	Resistor, Composition	68 Ohms, ± 5%, 1W	5-115558-680
R-62	Resistor, Composition	100 Ohms, ± 5%, ½W	5-115557-101
R-63	Resistor, Precision	1.0M, ± 1%, ½W	1-117802-1004
R-64	Resistor, Precision	5.0M, ± 1%, ½W	1-117802-5004
R-65	Resistor, Precision	5.0M, ± 1%, ½W	1-117802-5004
R-66	Resistor, Precision	1.0M, ± 1%, ½W	1-117802-1004
R-67	Resistor, Precision	390K, ± 1%, ½W	1-117802-3903
R-68	Resistor, Variable	100K	19-211473-104
R-69	Resistor, Precision	150K, ± 1%, ½W	1-117802-1503
R-70	Resistor, Composition	220K, ± 5%, ½W	5-115557-224
R-71	Resistor, Composition	10K, ± 5%, 2W	5-115559-103
R-72	Resistor, Composition	330K, ± 5%, ½W	5-115557-334
R-73	Resistor, Composition	220K, ± 5%, ½W	5-115557-224
S-1	Switch, Rotary		119867
S-2	Switch, Rotary		119652

PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	VALUE	BRUSH PART NO.
S-4	Switch, Rotary		118828
S-5	Switch, Rotary		119052
T-1	Transformer, Power		121553
T-2	Transformer, Filament		123991
V-1	Tube, Electron 5751		119028
V-2	Tube, Electron 12AT7WA		122813
V-3	Tube, Electron 12AT7WA		122813
V-4	Tube, Electron 5687		122828
V-5	Tube, Electron 5687		122828
V-6	Tube, Ballast 3TF4		119373
V-7	Tube, Electron 6X4		117614
V-8	Tube, Electron 6080		115267
V-9	Tube, Electron 5751		119028
V-10	Tube, Electron 0A2		107098
	Cable, Signal		223385-501
	Cable, Power		117630

TUBE SOCKET PIN VOLTAGES

1. Voltages should be measured under the following conditions:
   a. VOLTS/LINE attenuator set in the "OFF" position.
   b. CALIBRATE—20 LINES control fully counterclockwise.
   c. A 1500 ohm resistor connected across the output terminals (pins "B" and "C" of the output connector).
   d. Voltage across the output resistor adjusted to zero (0 volts) by means of the PEN ZERO control.
2. D.C. measurements should be made with a DC voltmeter with a minimum of ten (10) megohms input impedance.
3. A.C. voltages should be measured with an accurate RMS AC voltmeter (20,000 ohms per volt or higher).
4. The +B voltage should be adjusted to 213 volts as described in the Operating Instructions under "ROUTINE ADJUSTMENT AND MAINTENANCE—Power Supply Chassis".
5. All measurements should be made from the tube pin to —B (⏚) point, except where otherwise noted.
6. Variations in observed voltage readings from tabulated values do not necessarily indicate improper operations unless deviations exceed 10%.

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TUBE No.	TYPE	PIN NUMBER								
		1	2	3	4	5	6	7	8	9
V-1	5751	165	86	88	Note 1		165	86	88	—
V-2	12AT7WA	110	Note 3	29	Note 2		110	Note 3	29	—
V-3	12AT7WA	110	Note 3	36	Note 2		110	Note 3	36	—
V-4	5687	213	110	113	Note 4		113	110	—	213
V-5	5687	113	23	26	Note 4		26	23	—	113
V-7	6X4	—	—	—	—	—	—	—	—	—
V-8	6080	—	—	—	—	—	—	—	—	—
V-9	5751	Note 3		65	Note 2		Note 3		65	—
V-10	0A2	—	65	—	—	213	—	—	—	—

NOTES:

1. 4.4 to 5.8 volts A.C. measured from pins 4 and 5 to pin 9.
2. 6.3 volts A.C. measured from pins 4 and 5 to pin 9.
3. Do not measure.
4. 6.3 volts A.C. measured from pins 4 and 5 to pin 8.

V_1 5751 V_6 3TF7

V_2 12AT7

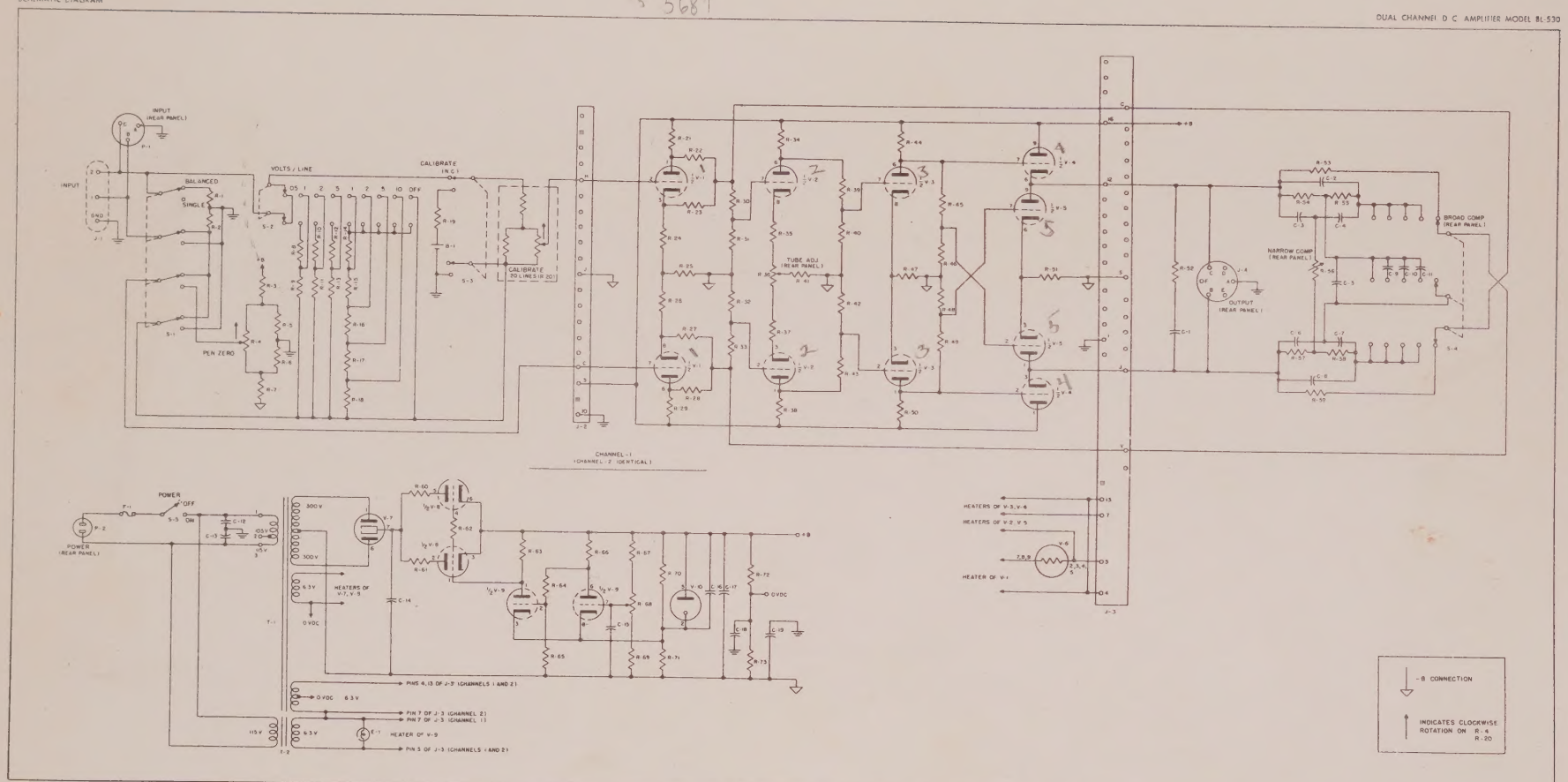
V_3 12AT7

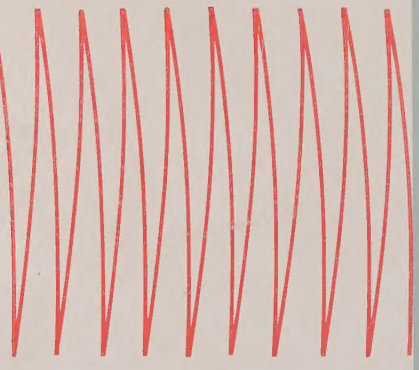
V_4 5687

V_5 5687

SCHEMATIC DIAGRAM

DUAL CHANNEL D C AMPLIFIER MODEL BL-530





brush INSTRUMENTS

DIVISION OF

37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

MP MASTER

MA34652

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